allocation after relocation of the worst three microwave stations by each licensee and up to 36 percent of the Chicago area would have no spectrum available. In Houston, only 13.5 MHz of useable spectrum would be available, on average, with a 20 MHz allocation after relocating the three worst-case incumbents in each PCS licensee's spectrum block and up to 35.2 percent of the Houston area still would have no spectrum available for PCS.[11/] These results are, again, only averages; in each case, significant geographic portions of the market are blocked entirely by microwave users.[12/]

Studies have focused on major markets for good reason. If PCS cannot be brought to the major population centers of the United States, it will never emerge as an effective telecommunications service. Moreover, some 50 percent of Americans live in or near the top ten major trading areas, where microwave congestion is and will be a significant problem. However, microwave usage is not solely a large city phenomenon. Microwave users operate throughout the United States, in mid-size cities, small towns, and rural areas. Cities such as Orlando, Florida (36 paths, 32 public safety) and even Tulsa, Oklahoma (24 paths, 11 public safety) and Bismarck, North Dakota (15 paths) have significant microwave usage.[13/] Microwave congestion under allocations as small as 20 MHz will be a fact of life even in sparsely populated areas, because a single microwave user can block all spectrum in a PCS licensee's assigned frequencies. Microwave congestion in the 2

11/ See Engineering Supplement of J. Barclay Jones, Attachment A to Letter from Wayne N. Schelle to Chairman Alfred C. Sikes (Gen. Docket 90-314, Jan. 8, 1992).

12/ For this reason, it is meaningless to point out that the Hong Kong digital cellular system has been allocated only 5 MHz of clear spectrum. This allocation would be uniformly clear throughout the entire geographic area to be served; under an allocation that yields an effective average of 5 MHz, after sharing, entire geographic areas would be blocked out entirely by microwave use. Moreover, PCS is not digital cellular. Because of the size of this allocation (which may have to be supplemented to meet capacity demands when commercial service is inaugurated), the Hong Kong system will be limited to compressed voice service. PCS in the United States will be much more than simply a voice service (as will, for that matter, cellular).

13/ See Comsearch, Microwave Path Usage On 1850-1990 Band (Gen. Docket 90-314, April 1993).

GHz band is a nationwide problem demanding a nationwide solution.

The fact that some PCS applications will permit some use of microcells -- generally defined as base stations with radii of 1000 feet -- does not obviate the need for a sufficient spectrum allocation. To begin with, any vision of a PCS based entirely on microcells is not in the business plan of any PCS Action member (or any PCS proponent of which we know). Base station radii of up to three miles will be necessary for cost-effective deployment of PCS, even in metropolitan areas but especially in less densely populated areas; a vision of PCS based entirely on 1000-feet microcells no longer exists.[14/]

B.

Delays Implicit in Relocation. PCS will enter a highly competitive marketplace in which entrenched cellular entities have achieved wide-area, regional coverage. To be competitive with cellular and wide-area ESMR services, PCS will be forced to build out entire systems for an initial launch. The vast majority of the base stations in a PCS system must be active when the service is offered to the public or PCS will fail to gain a competitive foothold. PCS, then, cannot afford the luxury of rolling out its service gradually as cellular did in the competition-free environment of the mid-1980s. Systems elsewhere in the world recognize the imperative of building virtually complete systems by the first day of commercial launch; in the United Kingdom, Mercury Personal Communications built 250 cell sites before turning on the first user, and in Germany, the PCS licensee will have to build thousands of cell sites before launching its wide-area service. PCS licensees must have a sufficient amount of spectrum to permit wide-area service to be initiated on the first day of commercial launch.

Beyond doubt, delay in the full inauguration of PCS must be avoided. Insufficient spectrum allocations, however, would

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14/ And, of course, comparing digital PCS to analog cellular is misleading -- cellular carriers are converting to digital technologies with the same efficiency as PCS digital technologies and are implementing these technologies in 25 MHz of clear spectrum. The need to accommodate current analog users of spectrum may require part of a cellular carrier's spectrum to be reserved. However, the magnitude of that reservation will not approach the level of spectrum preemption that incumbent microwave users will cause to PCS licensees, and alleviation of the cellular reservation is entirely within the control of the cellular licensee.

stall PCS implementation and development in markets across the country because PCS licensees would not have access to the spectrum needed to implement PCS. PCS licensees would be forced to abandon the sharing technologies that the Commission has found so valuable and revert to a mandated band-clearing strategy. Forcing a clearing of the band would provoke delays of two types.

First, too-small allocations would prevent PCS licensees from having sufficient spectrum even to begin PCS implementation in the near term. Comsearch, an independent frequency coordination firm, has found that a 20 MHz PCS allocation would require 100 percent of public safety licensees and 50 percent of all licensees to be relocated during the first three years after PCS licensing.[15/] PCS licensees thus would be forced for their very survival to begin negotiations with incumbent microwave users during the "transition period."

During this "transition period," microwave users would be under no obligation to relocate or to limit their demand for payment to their costs of relocating. PCS licensees, fresh from paying auction prices to attain PCS spectrum, would be forced to negotiate in an open market -- essentially, a second, private auction -- to gain access to the very spectrum they had been licensed. Microwave licensees, moreover, will have every incentive to attempt to reap the perceived market value of the spectrum they have been licensed. These negotiations would be inordinately time-consuming and expensive, delaying service to the consumer and driving up the cost of the service that ultimately will be provided. Under this scenario, PCS stands to lose the very characteristic that has driven the optimism of the PCS industry -- the ability to offer a low-cost, mass market service that will meet, for the first time, the tetherless telecommunications needs of the majority of the American public.

Second, even if negotiations can be completed successfully, the logistics of relocating microwave licensees would cause significant time delays. Too-small spectrum allocations would require all PCS licensees to be working to relocate microwave users at essentially the same time. Equipment for relocation bands, which are just now being rechannelized by the Commission, would have to be produced in mass quantities in time for this relocation; innumerable engineers would have to be deployed to effectuate the relocation. Although some have intimated that relocation of

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15/ See Comsearch, Spectrum Allocations and Their Impact on Microwave User Relocations: A Case Study (April 12, 1993).

microwave users requires little more than switching microwave radios, this is not the case. Many systems are complex with multiple paths, and will require substantial time to perform the frequency coordination, engineering, licensing and installation. Today this process often takes 18 months for a single link. If relocations such as these will be necessary in every major market in virtually the same time frame, the industry will be unable to respond and the inauguration of PCS will be inevitably delayed.

The public interest demands that PCS be implemented as quickly as possible. Until PCS is implemented, cellular will not be subjected to full and direct price and service competition; American consumers will be harmed by delay.[16/] As all the studies that have been performed show conclusively, PCS is a highly demanded service.[17/] PCS will create 300,000 high-quality new jobs for Americans.[18/] It will permit our service and manufacturing sectors to seize the lead in a $214 billion industry wireless market by the year 2000.[19/] PCS also will provide competition to existing telecommunications services, competition that the FCC has estimated will save consumers billions of dollars.[20/] Because of the benefits PCS can bring to American consumers, our economy and our balance of trade, both houses of Congress have crafted legislation

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16/ See General Accounting Office, Telecommunications: Concerns About Competition in the Cellular Industry (July 1992). In the United Kingdom, both cellular carriers lowered their prices between 12 and 16 percent six weeks before Mercury PCS was scheduled to be introduced to the public.

17/ See supra notes 2-4.

18/ See Letter from Kurt A. Wimmer to Cora Beebe, Office of Management and Budget, April 15, 1993 (PCS will create 280,867 jobs) (attached); see also Telocator, Why Personal Communications Services Need to Be at the Top of the Domestic Policy Agenda ("New, emerging PCS businesses promise to create 250,000 new jobs").

19/ "Global PCS," Presentations by James P. Caile, Vice President, Motorola, Inc., before ABA/FCBA International Telecommunications Seminar, June 8, 1993.

20/ See Letter from Alfred C. Sikes, Chairman, FCC, to President George Bush, April 28, 1992, at 14 (regulatory review finding that PCS will save American consumers between $2 billion and $5 billion per year by providing competition to cellular telecommunications).

requiring quick regulatory action to begin the licensing of PCS. Insufficient spectrum allocations would frustrate the very goals Congress expected to achieve by mandating quick regulatory action.

III.
Other Reasons for 40 MHz Assignments

As pivotal as the microwave congestion issue is to the debate over spectrum allocations, it is not, by any means, the sole reason for an allocation of 40 MHz per PCS licensee. Throughout the world, countries have forced incumbent microwave users to vacate the 2 GHz band altogether to accommodate PCS and then have granted 30-50 MHz of clear spectrum to PCS licensees. In the United Kingdom, for example, two PCS licensees each have been allocated 50 MHz of clear spectrum, and in Germany, one PCS licensee has been allocated 30 MHz of clear spectrum. This is not inefficient or uninformed spectrum management policy on the part of these countries, to be sure; rather, these countries are seizing the opportunity to permit PCS to provide much more than simply a digital cellular service. The same path should be followed here.

The Population to be Served. Cellular companies serve some 4 percent of the United States' population on 25 MHz of clear spectrum, and now claim to be at capacity in major markets. Independent marketing studies suggest that between 40 and 60 million Americans -- up to 25 percent of the population of the United States -- will subscribe to PCS. Even if clear spectrum were being assigned to PCS licensees, a significant amount of spectrum would be necessary to serve such a vast number of Americans even with efficient digital technology.[21/] In fact, a comprehensive study on spectrum requirements performed by Telocator found that PCS operators will need

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21/ Although PCS will utilize efficient digital technology, cellular carriers too are converting to technology promising the same degree of efficiency. The claim that "less is more" because PCS can utilize tiny microcells and even picocells to reuse spectrum more effectively is a complete red herring. No one questions that cellular licensees could install smaller cells as well. This vision, moreover, is based on the limited, small-cell-only vision for PCS held by our competitors. Even assuming such systems would be built, this requirement would significantly raise the cost of initiating PCS service.

between 36 and 49 MHz of clear spectrum each to service the public's demand for PCS.[22]

The Need for Wireline-Quality Voice. Voice quality is a crucial issue emerging from the American studies of the potential market for PCS. American consumers will demand wireline-quality voice transmission. If wireline-quality voice cannot be achieved, PCS will not be able to break the local exchange monopoly and provide competition in the local residential service. High-quality voice transmission demands high-capacity voice coders ("vocoders"). Vocoder rates providing high voice quality cannot be accommodated in very narrow spectrum allocations. The Telocator spectrum study also found that 36-49 MHz of clear spectrum per licensee would be required for an "optimistic" deployment of current technology using 32 Kbps voice coding.[23] The implementation of effective in-building PCS, or any other PCS uses that will require consumers to replace traditional wireline services with wireless service, will require wireline-quality voice transmission.

The Need for Data Transmission. PCS is, emphatically, more than a voice service. Wireless data transmission is one of the most highly demanded members of the PCS family of services. Wireless computing devices -- including laptop and notebook computers as well as "personal digital assistants" -- must be served by a robust and high-quality digital transmission system. Wireless facsimile services and data modem communications alone will require 32 Kbps transmission for acceptable performance; advanced digital interfaces such as wireless ISDN will require at least 64 Kbps per user. Given any significant level of penetration and usage, these services simply cannot be wedged into allocations smaller than 40 MHz per PCS licensee.

PCS is ideally positioned to provide an infrastructure for wireless computing. In addition, PCS can and should take the lead in facilitating the United States' next-generation information infrastructure by providing high-speed, high-capacity wireless data transmission. These services will

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22/ See Telocator PCS Technical and Engineering Committee, Telocator Spectrum Estimates for PCS Report: An Analysis of Clear Spectrum Required to Support Emerging PCS Services 3 (1992). The study noted that its estimate "will understate the amount of spectrum needed if significant fixed microwave links remain in service after 2002." Id. at 8.

23/ See id. at 3.

encompass high-speed wireless facsimile services and large-capacity data transmission services. The new high capacity, wired computer networks are expected to be image and video driven. Newspapers, for example, will deliver news on personal digital assistants with on-command videos of events and sound recordings of speeches, not mere scrolling of text. More fundamentally, if the personal digital assistant of the future cannot match the wired computing network's ability to decompress a multimedia file on the fly or to support a video call, the future mobile user and the mobile network will be cut off from the standard way of doing business.

These new applications will require significant bandwidth. Using an asymmetric algorithm, for instance, every multimedia session would require occupying bandwidth that could have accommodated simultaneous voice channels ranging in number from approximately 10 (at vocoder rates of 32 Kbps) to 50 (at 9.6 Kbps). This demand for bandwidth makes it very unlikely that PCS can provide high-speed data services if these services must contend for less than 40 MHz of shared spectrum. PCS's potential data applications would be forever lost under 20 MHz and 30 MHz spectrum allocations.

The Potential for Information Services. PCS also can provide highly demanded information services, including graphics, imaging, and, in time, compressed video in real time. These applications will permit advances in health care delivery and education, particularly in less densely populated areas, and could revolutionize how businesses communicate. The potential for cutting-edge wireless multimedia applications is an important part of our vision for PCS; this vision will expand access to information to large sectors of the American public that have not yet been able to participate in the telecommunications revolution. These services will be lost to the American public if PCS does not receive an adequate spectrum allocation.

IV.
Rural Allocations

Some may argue that rural areas will not require the same intensive use of the spectrum that will occur in densely populated urban areas. One should not, however, leap to the conclusion that it is an inefficient use of spectrum to allocate 40 MHz per licensee throughout the United States, including in rural areas. Rural telephone companies may put PCS spectrum to intense use by serving traveling and commuting subscribers from surrounding areas and using another portion of PCS spectrum to replace archaic wired infrastructures with advanced, cost-effective digital wireless voice and data

services. The flexibility of use inherent in PCS spectrum may finally permit those living in rural America to be every bit as advanced a part of our national telecommunications infrastructure as are our urban citizens.

The fact that all rural areas may not require 40 MHz per PCS licensee should not be seen as inefficient but instead should be viewed as a necessary side-effect of the manner in which the Commission has allocated spectrum for more than 60 years. It also could be argued, for example, that it is inefficient to protect the same 400 MHz of spectrum for VHF and UHF television in Truth or Consequences, New Mexico and New York City. It is undoubtedly more efficient to license PCS spectrum to some entity, even in rural areas, than to permit it to lie unassigned and fallow. It would make little sense to create a regional patchwork quilt of allocations, and it would make even less sense to define the services that will be available in cities by spectrum needs that are perceived in less-populated areas.

V.
Conclusion

PCS can reach its full potential in the United States only if PCS licensees have access to a sufficient amount of spectrum to avoid interference to incumbent microwave users, provide high-quality voice and high-capacity data transmission services, and respond to the service demands of consumers in both urban and rural America. The studies objectively addressing PCS spectrum requirements unanimously point to the option of assigning PCS licensees 40 MHz each. With this allocation scheme, PCS can be implemented swiftly; it can reach millions of Americans; it can provide high-quality voice and data services; and it can energize the telecommunications marketplace, creating jobs, competition, and tax revenue. It will permit the United States to move ahead in world competition and strengthen our domestic economy. With the critical needs at stake, the Commission can afford to do no less.

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April 15, 1993

BY MESSENGER

Ms. Cora Beebe
Office of Management and Budget
New Executive Office Building
725 17th Street, N.W., Room 9202
Washington, D.C.

Re: Personal Communications Services

Dear Cora:

As we discussed last week, we have estimated that the inauguration of personal communications services ("PCS") would create 300,000 good new jobs. This estimate is consistent with an estimate by Telocator[1/] that 250,000 service jobs and 50,000 manufacturing jobs would be created by the implementation of PCS. Telocator also has estimated that 60,000,000 Americans will subscribe to PCS by the year 2002.

Our specific analysis shows that PCS will create some 280,867 jobs by the year 2008 (or by 2002 under Telocator's projections). These jobs would be created in three broad categories: direct employment by PCS companies, indirect employment, and manufacturing employment.

Direct Employment (102,134 jobs). The analysis begins with employee-subscriber ratios drawn from other start-up telecommunications industries. At mid-point in the PCS industry's development, the analysis utilizes employee-subscriber ratios consistent with current cellular industry

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[1/] Telocator is a long-standing trade association representing companies in the cellular, paging and personal communications industries.

employment.[2/] Rather than continue with that ratio, the analysis utilizes more conservative ratios as the PCS industry grows to reflect greater efficiencies being realized.[3/]

Indirect Employment (127,667 jobs). This category includes dealers, distributors, resellers, consultants, engineering, billing and maintenance contractors, and other types of jobs that are created indirectly by the activities of PCS licensees. It is based on ratios that have been experienced in the cellular industry, which provides a useful analogue for PCS. The use of cellular figures is conservative in that PCS may be significantly more infrastructure-intensive than cellular and thus produce more indirect employment in engineering and construction services in its growth years.

Manufacturing Employment (40,853 jobs). The analysis assumes an export-import ratio of only 1:1.25 (that is, we export 25 percent more than we import). This is also quite conservative; as you know, our balance of trade in wireless telecommunications equipment traditionally is quite good and will improve if we can implement PCS swiftly and thus gain a foothold in the immense international market for PCS.[4/]

[2/] This analysis is very conservative in that it begins with employment ratios associated with the cellular industry rather than significantly lower ratios associated with the landline telephone industry (which if applied to PCS would probably double our job estimate). Some would argue that the latter figures may be more appropriate for PCS in the long run, because PCS will become more of a competitor to local exchange telephony as it matures.

[3/] This analysis is significantly more conservative than some analyses that analyze PCS at maturity based on current cellular employment figures (that is, the cellular industry has created 100,000 direct and indirect jobs with 11,000,000 current subscribers; if the PCS industry serves 60,000,000 subscribers at maturity, it should employ more than five times as many employees, or at least 500,000).

[4/] Many would argue that this figure is very conservative because the types of PCS being developed in the United States will leapfrog over more rudimentary technologies being developed in the European Community and the Pacific Rim. If PCS is implemented swiftly, the United States will capture a greater share of the international equipment market, a

The number of jobs created per dollar of manufacturing output is consistent with the current employment practices of large telecommunications manufacturers with whom we consulted in crafting this analysis.

Please give me a call with any questions about this analysis. We have not forgotten your invitation for comments on specific auction processes that could be utilized and will provide comments to you on that matter soon.

Very truly yours,

Kurt A. Wimmer

Enclosure

cc: Ronald L. Plesser, Esq.

---

higher export-import ratio would be justified, and more jobs would be created.

American Personal Communications

May 10, 1994

The Hon. Reed E. Hundt, Chairman
The Hon. James Quello, Commissioner
The Hon. Andrew Barrett, Commission
Federal Communications Commission
1919 M Street, N.W., Eighth Floor
Washington, D.C. 20054

Dear Chairman Hundt , Commissioner Quello
and Commissioner Barrett:

Attached is an advance copy of an article expected to be published in next month's PCIA Journal and in other publications that we thought would interest you.

We asked Mercer Management Consulting to apply its significant base of independent research on the PCS marketplace to the important competitive issues confronting the Commission and the PCS industry. Although we do not agree with all the conclusions of the article, we do believe it makes several important points:

1. "The sustainability of price competition depends largely on the relative strength of the industry and its players. Competitive strength ultimately is measured in terms of a firm's long-term cost structure. Wireless costs are driven primarily by local/regional scale, which translates into minutes of use and customers. If new entrants are unable to build a sufficient relative market share, they are unlikely to survive long enough to challenge the market leaders on price and service" (pp. 5-6).

2. Even if the FCC auction is conducted by the end of 1994, the time needed for construction means that PCS licensees will emerge in the marketplace almost 15 years behind cellular incumbents, which have a significant head-start in customer base and marketing efforts.

3. Cellular will provide PCS-competitive services on its existing spectrum and is doing so today (see especially "Heading Off Competition: A 'How To' List for the Cellular Industry," p. 4). There are numerous recent examples of cellular taking preemptive strikes against PCS, including GTE's "TeleGo" service; Bell Atlantic's digitalization and implementation of microcells in Metro, airports and elsewhere; and Southwestern Bell's "FreedomLink" service. In Southwestern Bell's view, in fact, "PCS is simply more cellular. As our network continues to expand, we will be capable of

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providing this level of service." Cellular One, *On the Move* (Customer Mailing, April 1994).

4. Mercer finds that "only a few entrants are likely to survive in the long term" because of cost constraints on new entrants (pp. 6-7).

These points clearly support APC's position that for PCS to be an effective competitor for cellular and even telephony, it needs enough spectrum and viable, serviceable license areas from the start. Please do not hesitate to have your staff contact us with any questions concerning this article.

Respectfully submitted,

E.Y. Snowden
President

cc: Attached list of FCC personnel
Gen. Docket 90-314

The Making of Wireless Competition

A Delicate Balance Where Less Means More For Consumers

While there has been a great deal of debate about the legal and economic issues pertinent to wireless competition, relatively little discussion has centered on how the players will actually compete. What follows is our perspective on how the competitive dynamic in the wireless marketplace is likely to develop. Implications are drawn about how the right balance of competition can help achieve the public policy goal of maximizing consumer benefits.

P. William Bane, Dekkers L. Davidson, and Ronald E. Grant
Mercer Management Consulting

Competition. While it's often thought of only in terms of winning and losing, in reality it's about much more than that. In the evolving field of wireless communications, it's about producing the most tangible benefits for consumers. While there appears to be a large market for wireless communications service, competition will be a rough-and-tumble affair that will challenge even the most viable new entrants and few are likely to survive. Yet, strong competitors will be key to bringing lasting benefits to consumers. How competition is structured at the outset will have a big effect on consumers and competitors alike. Consider some parallels from the past.

Ten years after the advent of equal access competition in the long-distance arena, consumers have clearly benefited through frequent service enhancements and price reductions. And so have AT&T, MCI, and Sprint. The new entrants pushed AT&T to be a more effective competitor, and AT&T has also challenged the newcomers to upgrade their consumer offerings. Together, these competitors helped to reshape and grow the market for long-distance telephone service; as a result, there have been many winners. The benefits of strong competition for the competitors are increasing size and value of the prize. The benefits to the consumer are better service and lower prices.

However, we can also find less praiseworthy examples. Consider Atari and the original electronic game market. This industry in its first incarnation was set back three to six years when weak competitors began selling cheap, low-quality products. The situation worsened when suppliers started going bankrupt. Consumers who had initially been attracted to this form of electronic entertainment turned sour when they were abandoned. This was clearly a case of too many competitors undermining consumer welfare.

A similar story played itself out initially with cordless phones; today, strong, vibrant competitors have finally emerged to supply consumers with reasonable-quality products at reasonable prices, but unfortunately it takes a while to overcome the negative experiences of the early days of excess competition.

In most markets, excess competition is a meaningless term. Not in wireless communications. In this case, the future competitive structure of the industry is now being determined by the Federal Communications Commission (FCC) as it considers how to manage entry by new players offering Personal Communications Services (PCS). The outcome of these deliberations will affect all wireless consumers and competitors for years to come. The FCC must determine how much competition is enough and how much is too much.

This will require a delicate balancing of objectives: Having a large number of competitors is most likely to foster service diversity, at least in the short term, while entry by fewer but stronger competitors is most likely to ensure lower prices in the long term. Does the proper balance exist to achieve both service diversity and lower prices? How soon does the FCC need to act in order to ensure that this balance can be sustained?

"To achieve its goal of bringing the benefits of competition to the wireless communications market, the FCC must make it possible for bidders to offer a variety of services of reliable quality and to offer these services at prices that will attract the average consumer . . ."

Mr. Bane is a Vice President and Mr. Davidson a Principal in the Communications and Computing Group; Mr. Grant is an Associate at Mercer Management Consulting which is headquartered in New York. The analytic support for this article was drawn from self-funded research on the wireless communications marketplace presented by Mercer Management Consulting at its conference *PCS Revealed: Winners and Wishers in Wireless Communications* on February 9 and April 6, 1994.

To achieve its goal of bringing the benefits of competition to the wireless communications market, the FCC must make it possible for bidders to offer a variety of services of reliable quality and to offer these services at prices that will attract the average consumer while maintaining long-term profitability. But the overarching issue is timing: If a plan is not put in motion quickly, many of the potential benefits of competition could elude consumers. The longer it takes to introduce viable new entrants to this market, the more likely it is that the well-established cellular carriers will be prepared to fend off competition.

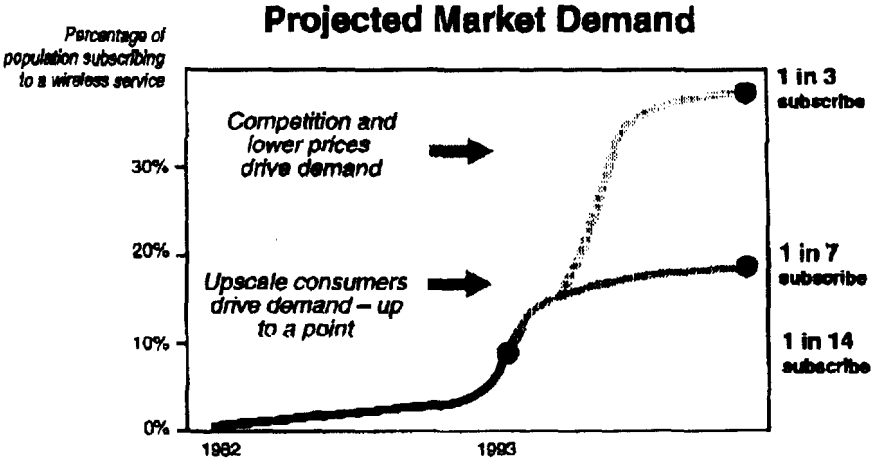
A View of Market Demand:

The market for wireless communications service will be enormous, but only if prices come down so the service is affordable for the average consumer.

During the past several years, numerous studies of the wireless communications marketplace have projected significant increases in consumer demand for PCS, ESMR, and cellular service (hereafter referred to collectively as "wireless service"). In keeping with these projections, subscriber levels rose a reported 46 percent in 1993, bringing the level of subscriber penetration from about 5 percent to almost 7 percent of the U.S. population.

According to Mercer Management Consulting's recent in-depth analysis of the wireless service market, this wireless penetration rate could increase another five-fold if prices are reduced enough to draw in the mass market consumer. Approximately 36 percent of the population – more than one in three people – would choose to subscribe to a wireless service if prices could come close to price levels for wireline services. This would translate into approximately 85 million subscribers.

So how do we get to this wireless future? Mercer discovered that the normal market diffusion process will cause a significant number of new, upscale consumers to subscribe to cellular service despite its high cost, thereby doubling cellular's market penetration to about 15 percent by as early as 1997. But without price competition, consumer acceptance will stall at that level.



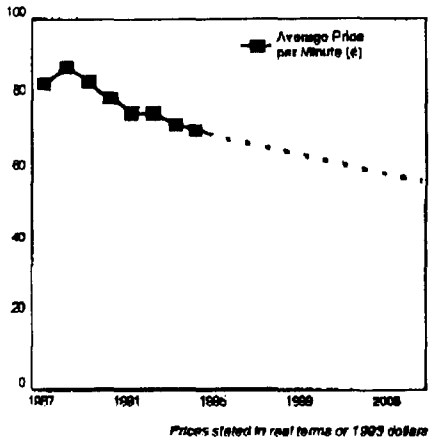
"... more than one in three people ... would choose to subscribe to a wireless service ... if prices are reduced enough."

Some in the cellular industry maintain that prices are already coming down, but a closer look at the numbers tells a more complex story. Although subscribers' monthly bills have in fact been shrinking, this is due not to lower prices but to a reduction in the average subscriber's usage. Between 1988 and 1993, the average cellular bill declined from $96.83 to $61.48 in *nominal* dollars, a reduction of 58 percent (or roughly 16 percent annually) in *real* terms. At the same time, however, according to CTIA data, usage declined from 177 minutes per month to 85 minutes per month, a reduction of 52 percent. Most of this usage reduction can be attributed to the changing mix of subscribers; many new subscribers use their cellular service far less than the early adopters. But *real* prices have declined only gradually (about 2.2 percent annually) during this five-year period, and prices for occasional users have actually increased in nine of the top ten markets.

Without more vigorous competition, consumers may wait more than 10 years for a wireless

No Significant Cellular Price Reductions

While the average monthly bill is lower, so is usage . . . and real prices have only been reduced slowly.



Prices stated in real terms or 1993 dollars

service priced with significant mass market appeal. The cellular companies have not significantly reduced their prices thus far in large part because it was not necessary to retain and grow their historically targeted customer segment. Not especially price sensitive, these customers include relatively few who actually pay for wireless service themselves; since most of their usage is for business-related purposes, most of their bills are paid by their employers. From the standpoint of the industry, these are the best kinds of customers: more likely to subscribe, more likely to use their cellular phones, and guaranteed to produce the highest margins, or profits, for cellular carriers. For these customers, the value derived from the service (e.g., ability to be productive during commuting time) drives their decision to subscribe much more than price.

To expand beyond this core group of business users, the wireless industry will need to change, and change significantly. Instead of concentrating its marketing and service efforts on growing the existing segment of today's users, which will soon be near saturation, the industry must shift its focus to defining the market segments of tomorrow and offering customers in those segments the services they will be willing and able to buy.

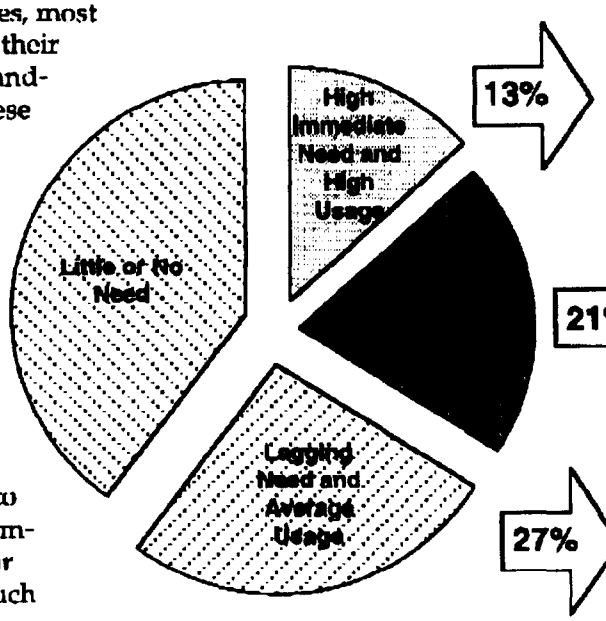
". . . the industry must shift its focus to defining the market segments of tomorrow . . ."

The next most promising segment of wireless customers – identified below as the "followers" – will subscribe to a wireless service primarily, if not exclusively, for personal use. To these customers, a wireless telephone will be attractive for its convenience and social entertainment value, and to some for the added security provided by having a telephone with them at all times. Because these customers will be subscribing to a wireless service for personal use, they will pay for the service themselves, and therefore are expected to be far more price sensitive than the early adopters. This segment is also likely to be interested in a variety of different high-quality wireless service offerings priced below standard cellular service packages today. They will probably favor more predictable pricing schemes structured on a flat-rate basis, in contrast with the prevailing usage-based structures in place today. First and foremost, however, lower prices will be the draw.

"Without more vigorous competition, consumers may wait more than 10 years for a wireless service priced with significant mass market appeal."

* * *

Who Are The Customers?



Early Adopters
. . . the *best customers*; many already use cellular service

Followers
. . . the *next best customers*; will be the core customer base for new entrants

Late Adopters
. . . the last group to become customers

Percentage of population

A View of the Competitive Dynamic:

Competitive rivalry could evolve toward intense price competition — but how soon and to what extent depends on the economic viability of the new entrants.

While the market opportunity is large, early competition is expected to be rough – especially for the new entrants. Even if the FCC's auctions are completed by year-end 1994, it will take another 18 to 24 months for new entrants to build their networks – meaning they will enter the market nearly 15 years after the first cellular entrant began operations. This time lag gives the cellular carriers an excellent opportunity to prepare for their new rivals.

Heading Off the Competition: A "How To" List for the Cellular Industry

Cellular and ESMR carriers can and should take several steps in anticipation of the threat to their franchise (and profitability). These include:

- **Sell. Sell. Sell.** Search for and sign up the best customers. New customers are currently subscribing to cellular services at a rate of 14,000 per day, and many of these fit the "early adopter" profile: high-volume users with an immediate need for service who are not very price sensitive. These customers provide 30 percent more revenue per subscriber than the "followers," and many may also sign long-term contracts (which will prevent them from switching to a new entrant) in exchange for lower-priced service. In addition to locking up individual customers, cellular carriers can target large corporations for long-term exclusive contracts.
- **Build Brand Name Recognition.** Build and reinforce brand name recognition. This will minimize the need to reduce prices when competition arrives.
- **Enhance Services.** Announce digital network upgrades and PCS-like services. The cellular carriers are currently rebuilding their networks and moving toward a lower-cost, more efficient digital system. New, innovative services, central to the promise of PCS carriers (e.g., pocket-sized phones, digital voice and data services), will weaken PCS providers' presumed advantages in terms of features.
- **Lock Up Distribution.** Establish strong relationships with existing retailers, resellers, agents, and other third parties that serve the industry as distribution channels (critical to finding and acquiring customers), forcing new wireless carriers to find alternative sales outlets.
- **Tie Up Suppliers.** Engage equipment suppliers to build out digital cellular networks, making suppliers unavailable when the PCS carriers need experienced help to build their new networks as speedily as possible.

The Early Days of Competition: *Innovation and Service Enhancements Likely*

What will the PCS players do to survive in this tough market? Having possibly invested a significant portion of their investors' capital at the PCS auction and another huge sum to build their networks, the new wireless entrants will need to capture customers and generate revenues quickly. And unlike the original cellular carriers, which had flexibility and built network capacity as they grew, the new wireless players will need to hit the ground running. This means that before they have recruited a single customer they must possess the technology and infrastructure to offer services equal to those of the incumbent carriers.

So where are the new entrants most likely to find their first customers? They have three choices:

(1) They can solicit or entice *existing customers* from the incumbents by offering a comparable cellular-like service with a lower price or better features.

(2) They can *find new customers* not yet served by the cellular or ESMR providers.

(3) They can do *a little of each.*

"Competition focused around price alone will be a very dangerous game for the new entrants to play, given their relatively high costs in their early days."

To take upscale customers away from cellular carriers, the new entrants will need to offer higher-value service (i.e., better service and/or lower prices). If they can deliver, this strategy could work well – but only if the incumbents and the other new entrants don't match their offer. However, the cellular carriers are likely to respond by matching price reductions, offering further service enhancements to retain their best customers (e.g., a better handset in exchange for an additional 15-month service contract that locks them in), or both. Very quickly, the new entrants are likely to find themselves in an extremely expensive fight for the high-usage segment.

Competition focused around price alone will be a very dangerous game for the new entrants to play, given their relatively high costs in their early days. An analysis of probable costs for wireless competitors in the New York MTA (the largest and possibly the best wireless market in the United States) indicates that the leading new entrant will have unit costs that are at least 50 percent greater than the cellular carriers in the first three years – and that is only if customer demand is explosive (e.g., on a track to a 30 percent penetration level in 10 years). If the market grows more slowly within this first three-year period (e.g., a 15 percent market penetration trajectory by 10 years), the new entrant faces costs that will be 800 percent greater than the cellular carrier. That's a daunting challenge and probably enough to ward off much price competition initially – if not the bid itself.

There may be a better alternative, however. Given the enormous mass market demand for wireless telephony, the new entrants might instead focus their sales and marketing efforts on pursuing currently untapped segments of the market. While mass market customers (i.e., the "followers") will not be as lucrative initially as those being served by cellular carriers, they could represent the thin wedge of entry for new players. They may be more open to types of wireless service that are different from existing service offerings.

"Should there be too many new entrants in the wireless market, competitive failures may abound."

For example, some entrants might seek to differentiate their service by offering unique or smaller handsets. Some may strive to limit the number of disconnected calls, while others may try to provide better voice quality, and so on. Another potential route could involve offering a wireless service with a limited "footprint" for originating calls (e.g., within a single community or the environs of a college campus). The success of such a service might depend on deep price discounts, but new entrants would have a good chance of tapping demand for this type of service because it doesn't directly challenge the premium-priced, wide-area service supplied by the incumbents. Such a consumer offering could be compared to the Japanese strategy for entry into the U.S. automotive market. By starting with subcompacts – for which there hadn't been much previous demand – the Japanese were able to gain a foothold in the American market without initially going head-to-head with GM, Ford, and Chrysler.

In theory, diversity of supply and variety of choice will all be good for consumers, although paradoxically too many choices can create confusion and lead consumers to choose "known quantities" – the most recognized brand names. This phenomenon played itself out during the mid-1980s in response to competitive offerings from nearly 400 long-distance resellers and providers following the break-up of the AT&T monopoly. Dizzied by the flurry of alternatives, the majority of consumers opted for the most familiar carriers: AT&T, MCI, and Sprint. Over time, consumers may become better educated about their choices, of course, but this will require providers to invest time and money (in advertising, special promotions, and new selling strategies); if this doesn't happen quickly enough, many new entrants will disappear from the competitive landscape. Should there be too many new entrants in the wireless market, competitive failures may abound.

Competition Matures: *Price Wars and Industry Consolidation*

If the new entrants are able to capture a meaningful portion of the wireless market early, the industry will then evolve to significant price competition. This should lead to a subsequent round of consolidation among wireless players.

The sustainability of price competition depends largely on the relative strength of the industry and its players. Competitive strength ultimately is measured in terms of a firm's long-term cost structure. Wireless costs are

driven primarily by local/regional scale, which translates into minutes of use and customers. If new entrants are unable to build a sufficient relative market share, they are unlikely to survive long enough to challenge the market leaders on price and service. While one or more of the lagging new entrants (e.g., one that did not capture a critical mass of consumers earlier) will probably attempt to drop prices in an eleventh-hour bid to gain incremental market share, attrition will be high and the duration of such a price war will be limited.

People's Express, for example, at first gained market share and challenged the incumbent trunk carriers in the domestic airline industry because it offered lower prices to East Coast travelers in markets where its costs were low. The established carriers were able to respond to this new entrant only to a limited extent in the early stages. Unfortunately for consumers, the established airlines then adjusted their routes, approaches, and prices and were able to rob People's Express of its all-important high utilization levels. (People's aided in its own demise by overextending beyond its core business.) This is an outcome the FCC must strive to avoid.

Unlike the airline industry, the wireless industry will have a more difficult time adjusting to competitive failures. When an airline fails, its assets may be gobbled up quickly by another airline if demand is strong. Aircraft can be repainted, airport gates reassigned, and personnel redeployed with relatively little difficulty. Integrating a failed wireless company's assets into an existing network would be a much more complicated task; it could take from 12 to 18 months or more, assuming the technologies (e.g., CDMA, TDMA, GSM) were similar. If not, the failed enterprise's only useful asset may be its list of stranded customers. And customers stranded with useless handsets are likely to be very unhappy consumers, victims of this destructive, competitive free-for-all.

"... customers stranded with useless handsets are likely to be very unhappy consumers, victims of this destructive, competitive free-for-all."

A Supply-Side View:

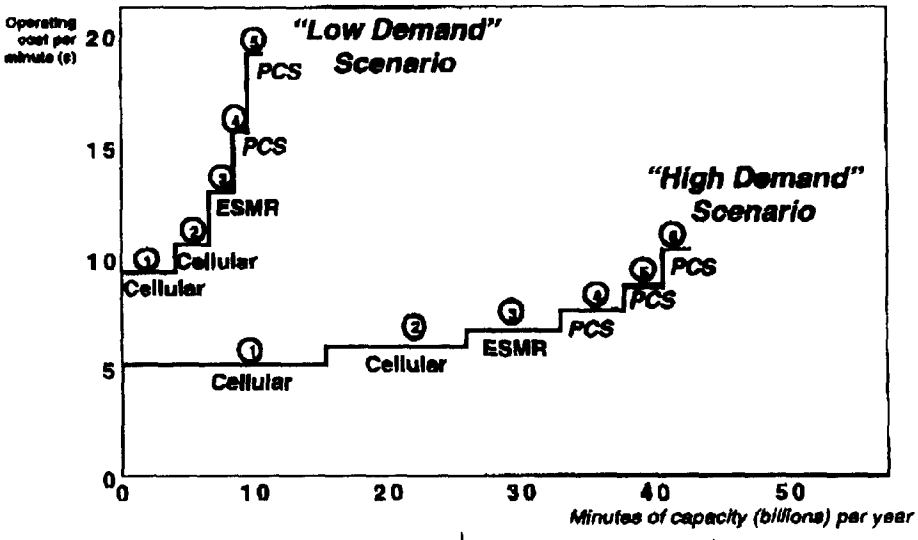
Market size and relative market share will determine competitive viability, and only a few entrants are likely to survive in the long term.

The best hope for the new entrant will be to attack large, untapped parts of the market. The more quickly new entrants can capture subscribers, the faster they will be able to achieve economies of scale and bring costs down. Although they will not be able to equal the in-place leaders' operating costs right off the bat, they may be able to survive long enough to get a more secure footing in the market.

In order to explore how many wireless players will be viable in a given market, Mercer examined the supply-side economics of wireless service in the New York MTA, the most populous MTA in the country. Given the size of this market, it could help establish the upper limits of wireless competition – the maximum number of competitors a single market could sustain. Using a 10-year projection, two contrasting market scenarios were tested: a "Low Demand" scenario, which assumed 15 percent market penetration in year 10 with an average subscriber usage of 150 minutes per month, and a "High Demand" scenario, which assumed 30

Competitive Positioning in the New York MTA

(Supply Curves in 10 Years)



percent penetration in year 10 with an average subscriber usage of 250 minutes per month. All key cost components were factored in.

Supply curves for the "Low Demand" scenario and "High Demand" scenario are shown on the previous page. The numbers above the horizontal lines indicate each competitor's ranking as measured by relative market share. The horizontal segments – the "runners" on each step – show the volume captured by each competitor, and the vertical segments – the "risers" – show each competitor's operating costs. While costs for 10 competitors were modeled in each scenario, the supply curves depicted include only those with arguably viable cost structures.

Since there are already three established players in the New York MTA, as in most markets, any new wireless entrant starts in fourth place. As a result, the new entrant also starts out with a smaller market share, lower volume use of its network, and higher costs than the three established players – its primary competitors. The higher costs will make it difficult for the new entrant to successfully employ the tactic most likely to help it gain market share – lowering prices. If the three market leaders decide to meet the new entrant's challenge by reducing prices to their marginal cost levels, the new entrant will find keeping up to be very tough sledding.

This argues for limiting the number of new entrants into each market if strong competition is desirable. In the New York MTA "Low Demand" scenario, Competitor 5 will struggle with operating costs that are likely to be twice those of the market leader. In the "High Demand" scenario, Competitor 6 (likely the third new entrant) must support operating costs 50 percent higher than those of the market leader. We cannot find examples of industries where competitors have survived with operating costs 50 percent higher than the market leader.

The Road to the PCS Auction:

What's the Best Competitive Balance?

The challenge for the FCC is to structure viable *long-term* competition in the wireless industry to maximize consumer welfare in the *short term*. The sooner healthy competition develops, the better for consumers *and* competitors alike.

In addition to the current plan, the FCC has been debating several alternative proposals for promoting competition.

- Seven allocations with two 30 MHz licenses, a 20 MHz, and four 10 MHz *(the current plan)*
- Six allocations of 20 MHz each
- Six allocations with three 30 MHz licenses and three 10 MHz licenses

All these models give the existing cellular carriers the opportunity to bid for spectrum so they could supplement their network capacity; for example, the seven-license scheme makes cellular eligible to bid for several of the 10 MHz licenses. While these 10 MHz licenses may possibly have some value to the cellular carriers, they seem unlikely to hold appreciable value for any other prospective bidder. Consequently, the FCC may not have many interested bidders for these smaller slots under its current plan.

Diversity: The plan that provides the greatest opportunities for different types of providers (e.g., set-aside licenses, curbing cellular eligibility in-region) could help promote service diversity and will be best for consumers *and* competitors alike.

"The sooner healthy competition develops, the better for consumers and competitors alike."

What criteria should be used to evaluate these three models for wireless competition? We believe there are three considerations that should drive the decision making about the competitive structure in the wireless arena:

Timing: The plan that delivers competition sooner will be best for consumers *and* competitors alike.

Viability: The plan that provides the greatest opportunity for new entrants to become viable – and ultimately to provide lower prices – will be best for consumers *and* competitors alike.

The 6 x 20 MHz plan, on the face of it, appears to provide the potential for the widest diversity of services and the greatest number of new competitors. Given the cost economics for new entrants, however, the likelihood is slim that so many entrants could be viable for long. Few – if any – will be able to attain critical mass quickly. Many will probably fail, and the losers will become candidates for acquisition. Why not let the market work this out? Because, by definition, competition will then have failed, with all the consequent implications. As a

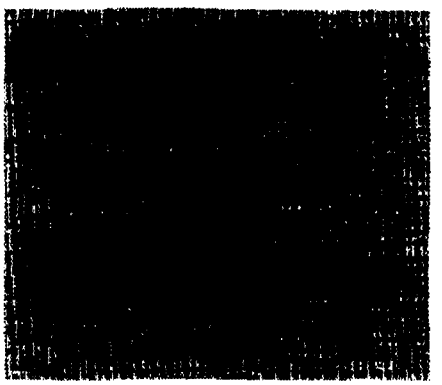
result, this plan fails on the viability count.

On the other hand, while the alternate six-license plan (three 30 MHz and three 10 MHz) could produce at least three viable competitors, regulatory timing factors may impede prospective entrants' ability to compete. Although such a proposal was previously considered and therefore may preclude the need for further regulatory study by the FCC, there is the possibility of delay. Prospective bidders may claim that they need time to reconsider their bidding and competitive strategies in light of such a change. Any delay of this length will be costly for consumers and will come at the expense of the new players. As the dust settles, the cellular carriers and ESMR providers will continue to build their competitive lead in the marketplace. They have no uncertainty about where and how to pursue customers and build networks. The new entrants will then start even farther back in the pack and at a greater cost disadvantage.

The FCC's plan to auction seven licenses, which is the plan currently on the table, clearly comes out on top when considering timing. By this point, it is well-understood by all the prospective players, and it has been the basis for business planning for both equipment manufacturers and potential service providers for a long time. And it at least holds open the door for diversity – if no one bids, the FCC can't be blamed for not trying. But is it also the best plan in terms of viability – will it produce the maximum number of competitors that can survive? In all likelihood, only two new competitors would make the cut under this plan.

"... the FCC can create a better competitive balance out of the existing seven-license plan by making subtle – but significant – changes."

However, the FCC can create a better competitive balance out of the existing seven-license plan by making subtle – but significant – changes. To help increase the value of all the new auction slots and to increase their competitive viability, the Commission could boost the power limits for new players, allowing them to serve suburban and rural customers more economically and to lower their cost structures. If the FCC also reduces the population-based build-out requirements across BTAs, the 20 MHz and 10 MHz licenses suddenly become more attractive for developing niche-



type offerings such as campus wireless services and in-building services. The FCC's goal of diversity of ownership will then be enhanced as entrepreneurs have the chance to compete in different parts of the wireless arena without facing head-to-head competition from the well-established incumbents or the larger new entrants.

These changes should allow the FCC to better approach the needed delicate balance that delivers maximum service diversity and minimum prices. This will be good for both consumers and competitors. It will also help the FCC attract the most interest at the auction and, ultimately, it will deliver competition – in its best sense – to the wireless marketplace. So in the making of wireless competition, less can mean more for consumers.

"These changes should allow the FCC to better approach the needed delicate balance that delivers maximum service diversity and minimum prices."